

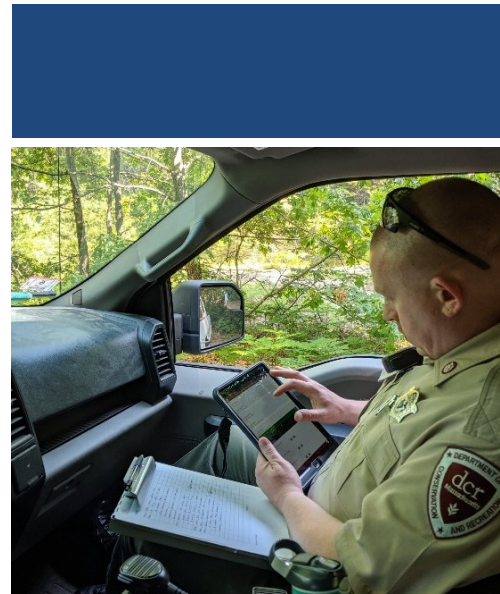
## 4.16 GIS

The Geographic Information Systems (GIS) program provides DWSP staff with the field and decision-making tools required to support all other watershed control programs. Over the past five years, DWSP's GIS program has evolved quickly to leverage new technologies available in the cloud, extending and enhancing the agency's capabilities beyond creating printable maps and conducting spatial analyses. Besides these traditional applications, GIS now provides the agency with an array of functions:

- Efficiently conduct field work.
- Realize savings in staff time by adopting modern workflows, such as streamlining or eliminating paper-based workflows.
- Visualize data in online dashboards that enhances decision-making.
- Generate information quickly and accurately for reports.
- Facilitate effective public/stakeholder engagement.
- Continue to conduct spatial analyses and create printable maps.

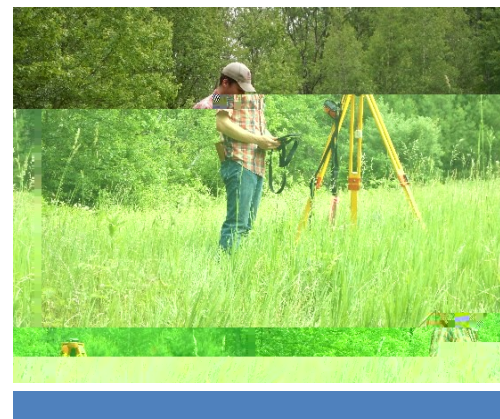
The GIS program's primary goal is to provide expertise, training, tools, and support to all watershed control programs to ensure that DWSP staff can accomplish program goals. In addition, the GIS program also provides DWSP representation amongst EEA's other GIS coordinators, ensuring that DWSP benefits as much as possible from GIS-related spending and initiatives within the secretariat. Over the past five years, the DWSP GIS program has risen to be a leader of GIS use within EEA.

The following sub-sections describe how GIS programs work across the watershed system. Most applications are used in all four watersheds, or have the capacity to work in any program or location; there are also a few examples of watershed specific projects. Therefore, there are no summaries similar to previous sections that detail work in each watershed or a specific list of



## Goal

Utilize Geographic Information System technologies to enhance and support all watershed management activities.



accomplishments. Instead, please see the Appendix for detailed examples of projects the GIS program has facilitated, oversees on an ongoing basis, or completed in the past five years. Projects have been selected because they highlight a representative workflow or represent the accomplishment of an important goal. There are also many operational sections which are independently completing excellent GIS work; their work is not included here unless otherwise noted.

Return-on-Investment (ROI) studies have been performed on several projects (see Appendix). The ROIs highlight how GIS can provide significant savings in staff time on both simple and complicated efforts. Small-scale projects make up the majority of projects undertaken by the GIS program; adding these efforts together demonstrates the positive financial impact of these new GIS based workflows.

#### **4.16.1 Field Data Collection**

GIS-supported field data collection allows staff to collect robust spatial, quantitative, and qualitative data quickly and easily on iPads while in the field. Over the past five years, the majority of paper-based workflows have been converted into more streamlined and efficient computer-based processes that utilize a suite of mobile apps designed to facilitate data collection. (Table 4-23).

DWSP utilizes a suite of tools available through Esri’s ArcGIS Online platform. These applications are crucial to the success of many programs’ data collection efforts; many even work in areas of the watersheds where there is no cell coverage. Data collected in this way can then be used within other applications supported through ArcGIS Online or can be brought into desktop GIS to support mapping and analysis.

**Table 4-23: GIS Field Data Applications**

<b>Application</b>	<b>Data Collection Format</b>	<b>Description</b>
Field Maps	Map-centric	A map-based data collection experience, allowing users to view their location on a map in relation to reference data. Supports data collection and editing, locating assets and their information, inspection workflows, note-taking and annotation, and automatic location tracking. Allows for collection of spatial, quantitative, qualitative, and image data.
Survey123	Form-centric	A form-based data collection experience which allows users to enter information into a responsive form that supports conditional visibility, defaults, complex calculations, and more. Great for supporting complex data collection needs and for enforcing data quality standards. Allows for collection of spatial, quantitative, qualitative, and image data.
QuickCapture	Rapid	Designed as a “big button app” to facilitate rapid (at speed) data collection. Allows users to quickly record observations while moving (e.g., on a boat) at speed by selecting from pre-configured options that minimize data entry time. Allows for collection of spatial, quantitative, qualitative, and image data.

#### **4.16.2 Dashboarding and Data Visualization for Decision-making**

The ability to visualize data and interpret trends is crucial to ensuring data is used in decision-making processes. In the past, this could be accomplished by working with data in programs such as desktop GIS, Excel, or R. While those modes are still effective, there are now online Dashboards that can be created to convey complex spatial and attribute information on a single screen. Dashboards can integrate maps, charts, lists, and graphics to create a visually appealing, interactive, and intuitive way to

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interpret data. DWSP is using Dashboards to present data trends and detailed information to assist in both decision-making and reporting, and as a method for communicating complex data trends to the public and stakeholders.

Dashboarding is currently used to support many internal programs workflows:

- Visualizing and reviewing information from the *Watershed Protection Act* database (see Section 4.8).
- Summarizing active *Construction General Permitting* inspection information (see Sections 4.8 and 4.11).
- Presenting information for quarterly reporting on requests made through the *Wachusett Region Work Order* system (see Section 5).
- Highlighting trends and hot spots of CMR violations or incidents recorded in the *Rangers Daily Log* (see Section 4.5).
- Displaying a series of *Road Infrastructure Management Experience* dashboards to present detailed information for planning and maintenance of internal road infrastructure (see Section 4.7).
- Provide statistics and data summaries on *Beaver Activity* for reporting purposes (see Section 4.4).
- Summarizing and presenting results of the *2022 Wachusett Creel Survey* to internal stakeholders (see Section 4.4).

Dashboards are also used to communicate complex or dynamic information to the public; some examples of public dashboards include:

- [DCR/DWSP Regional Gull Survey](#)
- [Quabbin Bird Harassment Program](#)
- [Wachusett Reservoir Aquatic Invasive Species Removal](#)
- [Quabbin Reservoir Boat Launch Area Rental Availability.](#)

#### **4.16.3 Reporting**

The GIS program has enabled DWSP staff to synthesize collected information into standardized reports with the click of a button – a critical step for translating data collection efforts into material that can be interpreted by both internal and external parties. Reports can include detailed information such as attribute data, map(s),

image(s), or summary statistics; templates can be as simple or complex as needed. Report templates are being successfully used by a variety of programs, including:

- Watershed Preservation Restriction Monitoring and Baseline Documentation Reports
- Watershed Protection Act Variance and Applicability Decisions
- Construction General Permitting Inspection Details and Summary Reporting
- Bird Harassment Program
- Ranger Quarterly CMR Violations.

#### **4.16.4 Data Management**

It is imperative to provide staff access to authoritative data for use in their daily mapping and analysis, ensuring that any decisions derived from geospatial data are made with confidence. There have been subtle shifts over the years in how DWSP accessed geospatial data; since the COVID-19 pandemic began, however, there has been a fundamental shift in the ways staff search for and access data. Prior to the pandemic, data resided in several on-premises servers, however DWSP switched to cloud data storage in the ArcGIS Online (AGOL) platform in mid-2021; this change to cloud data storage provides easy access to data from anywhere, whether working in the office, remotely, or in the field. ArcGIS Pro enables staff to:

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- Easily integrate with AGOL, which includes authoritative data from multiple sources, including DWSP, EEA and MassGIS.
- Leverage data collected in the field.
- Use locally stored data.

The GIS program is committed to ensuring continued access to a robust data catalog that enables staff to complete GIS tasks as required by their programs. Targeted training and an easy-to-use Data Inventory allow for quickly locating the data required to complete projects. In addition, governance standards of the online environment ensure that data is properly shared, documented and attributed by creators. The GIS program works continuously to ensure that data meets these standards.

#### **4.16.5 Workflow Automation**

Automation allows workflows to take advantage of some type of automatic action based on a “trigger.” A trigger could be a scheduled task on Windows, a Survey123 form submission, or a modification of an existing data record. DWSP is taking advantage of automation by integrating the many programs now using ArcGIS Online with Microsoft Power Automate. Examples of how this software is used include:

- Sending email notifications when a new request is submitted with the *Wachusett Region Work Order Request* form.
- Reminding Planning staff about upcoming decision deadlines for filings in the *Watershed Protection Act Database*.
- Automatically creating new folders in designated SharePoint locations for the *Environmental Quality Database*.
- Sending various notifications for *Quabbin Park Cemetery* internments.
- Updating the file status of *Environmental Quality Database* files when new entries are added to an Update Log.

Workflow automation also involves scheduled operations which can power real-time dashboards, process data for cleanup or update operations, backup content, or export data for use in other applications. This type of automation powers the Quabbin Reservoir Boat Launch Area Dashboard as well as perform automatic daily, weekly and monthly backups of DWSP's ArcGIS Online content for disaster recovery.

#### **4.16.6 Public/Stakeholder Engagement**

The GIS Program facilitates public engagement through traditional printed maps, interactive online mapping applications, and online applications such as StoryMaps or Dashboards. Over the past five years, several robust, user-friendly programs have been posted on the DCR website, including:

- [Watershed Protection Act Viewer](#) provides anyone the ability to view their property in relation to WsPA regulatory buffers.
- *DWSP Deer Hunter Field Map Viewer* and other hunting-specific applications allows hunters in the watershed system to access information at home and in the field. *This app is undergoing revisions; current version can be found on the [Quabbin Hunt website](#).*
- [Interactive Quabbin Reservoir Access Map](#) is a response to increased visitation of the Quabbin watershed during the first year of COVID-19.
- [DCR/DWSP Regional Gull Survey](#) shares information with partners and stakeholders through a dashboard
- [Quabbin Park Cemetery](#) facilitates an online experience for searching and exploring the cemetery.
- Engaging, informative stories are told through [The Watersheds](#), [Quabbin Park Cemetery](#), and [Preserving Massachusetts Forest Land Through the Forest Legacy Program](#) StoryMaps.

#### **4.16.7 Spatial Analysis**

Spatial analysis is key to answering questions about location-oriented problems and to understanding data in the context of geography. The GIS program provides DWSP staff with expertise and assistance, as needed, in completing spatial analysis projects, including:

- Revise and expand the Land Acquisition Program's Land Acquisition Model.
- Conduct an analysis of impervious surface and paved area percentages by watershed subbasin.
- Model Lake Trout habitat suitability in the Wachusett Reservoir.
- Assist in siting the best location for a new section of rail trail.

GIS staff will continue to help colleagues answer location-based questions and identify new ways to utilize spatial analysis to examine complex topics.

#### **4.16.8 Cartography**

This traditional function of the GIS program remains an important part of the way in which DWSP communicates geographic information with staff, stakeholders, and the public. Although the necessity of printed maps has diminished with the onset and adoption of online mapping applications, the GIS Program is able to use improved desktop GIS technology to provide high-quality, printable maps.

#### **4.16.9 Training and Education**

DWSP has GIS users of all skill levels within operational sections, ranging from Natural Resources to Rangers, and Environmental Quality to Watershed Maintenance. Providing training and continuing education opportunities is key to ensuring that DWSP staff feel empowered to use the available GIS technology. Training varies from project or workflow-specific, to more advanced desktop GIS training, to encouraging staff to take free trainings or workshops available through Esri (the GIS software vendor used by the Commonwealth). Empowering staff to feel comfortable using GIS-powered tools ensures that adoption of new workflows and technology is embraced by all DWSP programs.

#### **4.16.10 Five Year Objectives:**

- Provide GIS support to staff, including training, data curation and management, licensing, project development and management, analyses, and cartography.
- Ensure GIS staff receive and pursue training to keep skills relevant.
- Continue to curate and manage data catalog for GIS users ensuring data is up-to-date and relevant.
- Maintain existing workflows and tools so staff can continue to conduct business as usual.
- Design new and update existing tools and applications to constantly take advantage of new technology offered in the ArcGIS Online platform.
- Provide staff with recommendations on how to best leverage new and emerging technologies to ensure that DWSP staff and programs remain current.
- Continue to collaborate with other EEA GIS Coordinators to ensure that EEA's investment in GIS is leveraged to the fullest extent possible, ensuring that all secretariat GIS programs benefit from continued future investment.